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ENTOMOLOGICAL NEWS

VOL. LXXI JANUARY, 1960 No. 1

The Behavior of the Queen as Compared with the Worker in the Fungus-Growing Ants (Hym.: Formicidae)[1, 2]

By NEAL A. WEBER, Swarthmore College, Swarthmore, Pa.

The worker caste individual in the fungus-growers, as is normal among ants, is a female which has reduced reproductive organs, a smaller thorax without wings or sutures for them and other morphological differences. In colonies deprived of the functional female (the queen) the ovaries of one or more workers may form viable eggs that develop into males, again a common ant pattern. It is frequently observed that the females among ants are more durable than the worker and survive unfavorable conditions longer. New colonies usually start from isolated females that leave the parental nest and dig into the soil to form a new nest in which eggs are laid and to which food may be brought to the subsequent larvae.

While these differences between the queen and the worker are obvious, a direct study of the contrasting behavioral patterns of the two castes when confronted with a novel situation is not so often made. Following is an account of an experiment that supports the belief that the worker differs from the female in the reduction of her instincts.

A worker and the queen were the survivors in June, 1957 of a part of a colony of *Trachymyrmex urichi panamensis* Wheeler from Cerro Campana, western Panamá, taken on March 23. These and a second worker had been given a test tube

[1] Supported by a grant from the National Science Foundation.

[2] Paper presented before the Paris Congress, International Union for the Study of Social Insects, July 1957.

nutrient agar culture of the fungus of a Costa Rican colony of *Atta cephalotes* on May 13, after their own fungus garden had failed. It was noted that the queen forcibly removed a stray *Apterostigma* worker, also a fungus-grower, that wandered into this part of a common observation nest. Another *Apterostigma* was driven out by one of the workers. The *Trachymyrmex* adopted the *Atta cephalotes* fungus and built up a garden inside the test tube, using the nutrient agar medium for substrate. By May 30 one of the workers had died or been killed by the other ants and the remaining worker and female had dispossessed the *Apterostigma* of a culture tube given to them on the 13th, but of an entirely different fungus developed from another colony of the same genus. The *Trachymyrmex* were then given a culture of the fungus of a Panamanian *Atta cephalotes* colony. This fungus was also eaten faster than it grew and the two ants were given a tube culture of the fungus of an *Atta sexdens* colony on June 7, which was immediately adopted as were the other *Atta* cultures. By the 15th the ants had made a garden by cutting up agar blocks and adding bits of the fungus to them. This was suspended from the distal end of the tube, and inside it.

Insufficient moisture caused the garden to dry by the 23rd and the ants were given a culture of the fungus of *Sericomyrmex amabalis* on nutrient Sabouraud's dextrose agar with the following behavioral results: Beginning at 10:19 A.M. observations were made at 15 and 40 × magnification through a binocular stereoscopic microscope; the temperature was 24° C. The times given are all A.M.

10:19—Placed the fungus, 2.6 × 3.8 mm. in maximum diameters and 1–2 mm. high, on its agar base in the form of a block placed on wet sand 15 mm. from the queen. She immediately perceived it and went directly to the mass, exploring it with the apices of her antennae. Then she left this chamber and went through a tunnel into the empty chamber that had contained the other test tube cultures, only to find that the last tube had just been removed. The worker followed her.

10:21—The worker returned to the fungus and lapped the agar base 1–2 mm. from the fungus, then tasted the latter.
10:23—Both ants now on the block.
10:25—They returned to the empty chamber.
10:26—Both went back to the fungus, whose formerly upright hyphae had been beaten down by their licking and walking on it.
10:31—The female is straddling the fungus, which is roughly her own dimensions, and feeling it all over with palpi extended and antennae vibrating quickly.
10:32—The ants discover a hole in the wet sand 55 mm. distant that I had made for them. This hole 8 mm. in diameter and about 10 mm. deep.
10:33—The female returned to the fungus and bit it in places, then went away.
10:34—She went back and cut a piece about one-half the bulk of her head. No agar was removed.
10:35—The female took the piece to the hole and placed it about half-ways down against one side, where it stuck.
10:36–38—She removed and treated two more pieces similarly.
10:40—Both ants now on fungus mass, clearly tasting it briefly, then returned to the hole.
10:43 and 10:45—Two more pieces were removed by the female, the worker standing beside her as she cut the pieces but without otherwise participating. The worker has been moving about apparently at random.
10:46—The female is removing a piece of the fungus as before.
10:47½—Similar behavior by the female.
10:48½—She removes a piece the size of her head.
10:50—Both ants are in the hole and examining the gradually growing mass attached to one side.
10:51—The female removes another piece, the worker beside her but without participating.
10:51½–52—Two trips with fungus by the female, the worker going to the hole without carrying any.
10:52½–55—Four trips made by the female, the last time taking a little of the agar base.

10:56—She spends more than a minute examining the agar base, cutting and tasting it and cleaning her fore tarsi and antennae.

10:57½—She removes more.

10:59—About three loads are left at the original site and she explores the area within a radius of 30 mm.

11:00–01½—Three trips by the female, the last time removing the remainder of the fungus.

11:02–03—She explores this part of the chamber and visits the agar briefly, then joins the worker at the new site. Later the hole was completely concealed from above by the ants sticking sand grains to the glass ceiling directly above it.

The forming of an initial cell and later garden in the fungus-growers by the incipient queen has long been known and in *Atta cephalotes* it was noted (Weber 1937) that "this behavior pattern is so strong that several times I found virgin female ants, taken from the parental nest before their normal time for emergence and without this hyphal pellet, attempting to develop a fungus garden by gathering a cluster of sand grains and manuring them." In another instance (*loc. cit.*) "Two artificially dealated virgin females were placed in the same container. No animosity was shown to one another. By the next morning they were found to have excavated a narrow tunnel several centimeters deep and were busily engaged in deepening it. There being room in the tunnel for but one at a time, they were taking turns, one waiting for the other to come out with a load of sand and then immediately darting in before the other could deposit the load at the periphery of the chamber and return. They actually jostled one another in their eagerness to excavate. For eight days they occupied the tunnel together but on the morning of the ninth, one was found, dead but undamaged, firmly packed in sand at the end of the tunnel."

Discussion

The above instance of striking behavioral differences between the queen and her worker suggests an interpretation somewhat at variance with that which prevails.

In Wheeler's (1933) customarily exhaustive survey of the literature, an explanation of the behavioral differences between the two castes is focussed on the reduced reproductive system of the worker. In discussing the occasional substitution queen (p. 147) he summarizes the situation as one where the ordinary adult worker "must inherit the sensory, visceral and cerebral basis of her mother's activities. There is in the normal worker, therefore, merely a physiological curtailment of the purely egg-laying stage of the old female, but neither a disruption nor even a loosening of the neural anlage of her behavior cycle." After considering Legewie's views that the workers (p. 150) "are much more alert and display more versatile responses to their environment . . . than the females, because their brain is less powerfully influenced by their ovaries through the visceral, or sympathetic nervous system" he concludes that "there is no sharp constitutional neural difference between the female and worker." "That the neural endowment is really the same in female and worker and the differences in their behavior very largely phenotypic, or due to environmental influences, seems clearly to follow from the fact that both castes develop from eggs of the same genetic constitution and that the nervous system of the worker larva is very probably little if at all affected by the partial inanition or malnutrition to which it is subjected during its development."

My observations on numerous colonies of many species of fungus-growing ants indicate that the behavioral situation is very different. It has been my common experience that the only persistent, vigorous colonies and gardens are those that contain an egg-laying queen. The stimuli from the developing brood causes greater activity of the workers leading to the development of a larger fungus garden. So far as feeding of the larvae is concerned, I have no observations to show that the larvae crop the mycelium themselves and believe that they must always be fed the fungus by the female or worker. This food would seem to be qualitatively the same, whether given to the worker or female larvae. So far as duplicate experiments of the type detailed here are concerned, workers will accept a cultured fungus and build a garden but not as fast or as efficiently.

It would seem, therefore, that the worker differs from the female in having a less fully-formed brain, this term being used for a primary coordinating center in the head and not necessarily completely in the vertebrate sense. Neural tissue associated with the compound eyes and ocelli varies with their size and the worker usually lacks ocelli and has much smaller compound eyes than the male or female. Mandibular muscles and other structures may take up a larger part of the head so that external changes of it may have little to do with the brain size.

It was long thought that the worker was more "intelligent" (cf. Forel) than the female and it is obvious that the worker commonly responds more quickly to stimuli and is more of a "busybody" than the female. This immediate responsiveness is not necessarily an indication of superiority but rather serves well the needs of the colony for which the female is from the first responsible.

In conclusion, it may be suggested that the worker caste in fungus-growers, whatever may be its diverse functions, has a less complete brain than the female and with consequent reduction in instincts. It acts less efficiently in perceiving substrate and in forming the garden indispensable to this group of ants.

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Weber, N. A. 1937. The biology of the fungus-growing ants. Part II. Trop. Agr. (Trinidad, B.W.I.) 14: 223–226.

Wheeler, W. M. 1933. Colony-founding Among Ants with an Account of Some Primitive Australian Species. Harvard University Press, Cambridge, Mass. Pp. viii + 179.

Nomenclature Notice

All comments relating to the following should be marked with the Commission's File Number and sent in duplicate, before March 1st, to Richard V. Melville, Assistant Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W. 7, England.

Prothechus and **Alloneura** Rondani, 1856, suppression of (Order Diptera) (Z.N.(S.) 230).
Beraea Stephens, 1833, designation of type species (Order Trichoptera) (Z.N.(S.) 395).
Apatania Kolenati, 1847, designation of type species (Order Trichoptera) (Z.N.(S.) 427).
Aphrophora Germar, 1821, designation of type species (Order Hemiptera) (Z.N.(S.) 478).
saccharivora Peterkin, 1790 (**Phalaena**), suppression of (Order Lepidoptera) (Z.N.(S.) 1315).

For details see Bull. Zool. Nomencl. Vol. 17, Parts 1/2.

The Feeding and Culturing of Orthoptera in the Laboratory *

By S. K. Gangwere

The grasshoppers and allies are interesting in their habits and often economically important. Their generalized structure and relatively large size make them especially suitable for research. It is not surprising, therefore, that many investigations have been carried out on various members of the order and that, as a consequence, much has been learned about their laboratory culture. Unfortunately, most papers on the subject are not readily accessible, being widely scattered throughout numerous journals; they usually treat but a few economically important species, most often either grasshoppers, crickets, or cockroaches; and they describe unduly complex cages and other equipment and a very limited assortment of foods—usually artificial ones.

The author has been studying the feeding behavior of Orthoptera for many years, during which time he has maintained in the laboratory forty-two of the common Michigan species and has reared from eggs one or more species of most of the local families. The following is a list of the species successfully maintained for one to three months or more in the laboratory:

* Contribution No. 20 from the Department of Biology, Wayne State University, Detroit 2, Michigan.

Acrididae: Acridinae
(slant-faced locusts)
Chloealtis conspersa
Chorthippus longicornis
Orphulella speciosa
Pseudopomala brachyptera [1]

Acrididae: Oedipodinae
(band-winged locusts)
Arphia pseudonietana
Arphia sulphurea [2]
Camnula pellucida
Chortophaga viridifasciata
Encoptolophus s. sordidus
Pardalophora apiculata [3]
Spharagemon b. bolli
Spharagemon collare

Acrididae: Cyrtacanthacridinae
(spine-breasted locusts)
Melanoplus bivittatus
Melanoplus confusus
Melanoplus f.-r. femur-rubrum
Melanoplus keeleri luridus
Melanoplus b. bilituratus
Melanoplus s. scudderi
Paroxya hoosieri
Schistocerca alutacea

Tettigoniidae: Phaneropterinae
(bush and round-headed katydids)
Amblycorypha oblongifolia
Amblycorypha rotundifolia
Scudderia c. curvicauda
Scudderia f. furcata
Scudderia septentrionalis [3]

Tettigoniidae: Copiphorinae
(cone-headed katydids)
Neoconocephalus ensiger

Tettigoniidae: Conocephalinae
(meadow grasshoppers)
Conocephalus brevipennis
Conocephalus f. fasciatus
Orchelimum gladiator
Orchelimum nigripes

Tettigoniidae: Decticinae
(shield-backed katytids)
Atlanticus testaceus

Phasmidae (walking-sticks)
Diapheromera femorata

Gryllidae: Gryllinae (field crickets)
Acheta domesticus [4]
Acheta pennsylvanicus

Gryllidae: Nemobiinae
(ground crickets)
Nemobius f. fasciatus

Gryllidae: Oecanthinae
(white tree crickets)
Oecanthus nigricornis quadripunctatus [3]

Blattidae (cockroaches)
Blattella germanica [4]
Byrsotria fumigata [4, 5]

Gryllacrididae: Rhaphidophorinae
(camel crickets)
Ceuthophilus meridionalis

Tetrigidae (grouse locusts)
Tettigidea l. lateralis
Tetrix subulata

Mantidae (praying mantids)
Tenodera sinensis [4]

[1] Found difficult to maintain in the laboratory.
[2] Also reared from eggs in the laboratory.
[3] Found difficult to maintain in the laboratory.
[4] Also reared from eggs in the laboratory.
[5] Not a native species.

The present report emphasizing the feeding aspects of maintenance and culturing is based on information from the above studies, together with some rearing data from the literature. While it applies specifically to Michigan Orthoptera, wider application of its content may be made. The included material should be of interest to the orthopterist, to the experimental biologist utilizing Orthoptera as research animals, and to the biologist who merely wants to keep these insects alive for classroom or observational purposes.

Grasshoppers (Acrididae)

The recommended cage is a screen cylinder capped at both ends (fig. 1). The body of the cage is a piece of wire window screening 18 by 30 inches, rolled lengthwise and its two ends stapled together to form an open-ended cylinder. A sheet of glass 10 inches square forms the top. The floor is a standard metal cake pan 9 inches in diameter. If the pan is tin, it is lightly waxed or oiled to prevent rusting. Its inside surface is left uncovered or is covered with paper toweling, newspaper, or dry sand. The food-plants, which are placed on the floor, and the sides of the cage furnish the only necessary perches. Such a cage easily accommodates 20 or more average-sized orthopterans. To suit one's needs the dimensions of the cage may be altered in various ways; *e.g.,* a smaller cage may be fashioned by using standard fruit jar lids in combination with a smaller screen cylinder. This simple and inexpensive cage, the design of which was originally suggested by Dr. Irving Cantrall, of the University of Michigan, and then developed by the author, gives maximum visibility, yet causes minimum alteration of temperature, light, and humidity. It should be washed every few days.

Unless one wishes to control artificially the laboratory conditions, the cages are aligned on benches close to the windows of a dry, well-ventilated room, where sunlight falls on them. This is desirable because most adult grasshoppers survive best when the temperature during the day is high, the relative humidity low, and when they are exposed to sunlight at least sometime

during the day. If it is desirable to more closely approximate the conditions outdoors, the windows of the room are left open.

Although Michigan grasshoppers have marked food preferences, most of them accept a number of kinds of foods. If one wishes to use native food-plants they are clipped in the field and their stems thrust immediately into water-filled 5- or 8-ounce jars. A number of these can be conveniently transported in a wooden box of construction similar to that of a milk bottle carrier. In the laboratory the mouth of each jar is closed by wadding paper toweling between it and the stems of its plants; this prevents the grasshoppers from falling into the water and drowning. An appropriate-sized Erlenmeyer flask, which does not require wadded paper, may be used for the same purpose. One or two of the jars are placed in each cage. The insects can most easily reach the food if the foliage touches the sides of the cage. Genera of native food-plants the leaves and flowers of which are especially suitable to most Michigan slant-faced and band-winged grasshoppers are the grasses *Agropyron, Bromus, Dactylis, Danthonia, Phleum,* and *Poa;* those to Michigan spine-breasted grasshoppers are the grasses and herbs *Agropyron, Aster, Bromus, Chrysanthemum, Dactylis, Monarda, Phleum, Plantago, Poa, Rudbeckia, Solidago,* and *Taraxacum.*

A number of laboratory foods may be substituted, if desired, for native food-plants, except in the case of slant-faced grasshoppers, the Michigan species of which are entirely graminivorous. Various laboratory-grown potted plants, *e.g.,* wheat and other grasses, are recommended for all grasshoppers, including slant-faces. Lettuce is almost universally acceptable to Orthoptera and is easy to use; it is placed in jars, as above, or is thrown fresh on the floor every morning when the animals have resumed activity. Bran flakes, chicken mash, and shredded dog biscuits are excellent dry foods. Oat flakes are acceptable when used with other foods. Several special laboratory rations, *e.g.,* Haydak's mixture (Haydak, '42), may also be used. A little experience will dictate the amounts needed, but some kind of food should always be available.

It appears that most Michigan orthopterans do not drink regularly in nature (Gangwere, '59); thus, grasshoppers in the

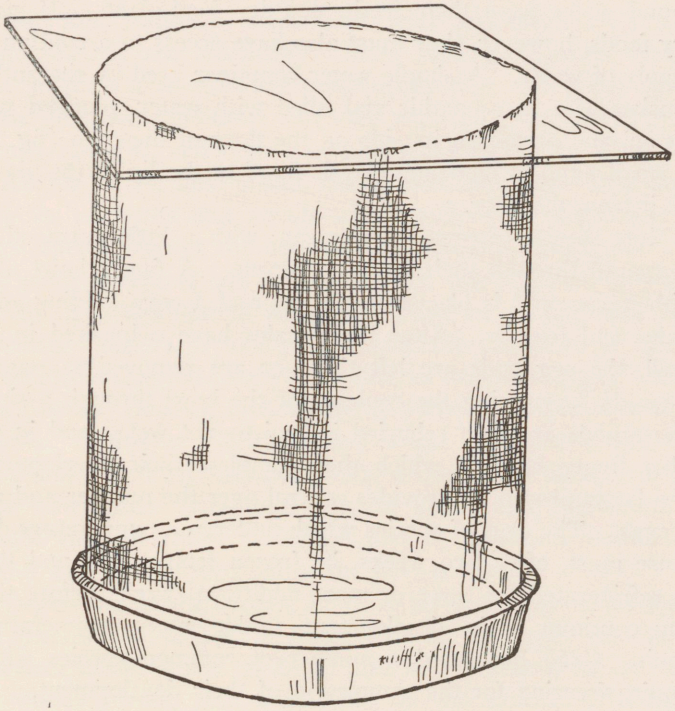

FIG. 1. Grasshopper cage.

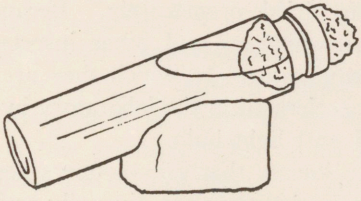

FIG. 2. Water receptacle.

laboratory, like their counterparts in the field, can obtain unbound water from their fresh, non-dry food-plants. If given dry foods, however, they must also have access to a continuous supply of water. A simple water container used by the author consists of a homeopathic vial filled with water, plugged with cotton, and placed on its side on the floor of the cage (fig. 2). A small lump of modeling clay is fixed to the lip of the vial to lift it from the floor.

Most species of grasshoppers can, with a little extra effort, be reared through their entire life cycle. A finger bowl filled with moist sand is placed on the floor of a cage holding adult males and females. After the females have oviposited in the bowl, the egg pods are left there or are removed at regular intervals by running the contents of the bowl through a sieve. These pods are then reburied in moist—not wet—sand in another finger bowl in which they complete their development. The latter procedure provides control over the number and age of eggs. The eggs of species which undergo a temperature diapause must, after two weeks, be frozen temporarily and then be refrigerated for three or more additional weeks before they can continue their development under room temperature. Bodine ('25) has listed a number of common species which require freezing for the completion of their development.

Once the nymphs have hatched, they are kept under approximately the same conditions as those to which the adults are subjected, but a finger bowl filled with moist sand is placed on the floor of their cage to provide additional moisture, without which some of them will mature with twisted legs and wings, these parts having dried prematurely. Because the rate of development of grasshoppers and other insects is largely dependent on the temperatures to which they are exposed, their life cycle may be accelerated in the laboratory by exposing them to heat from a 25-watt light bulb.

It has long been known that grasshoppers depart from most other orthopterans in that they are diurnally active (Gangwere, '58); therefore, one can observe their laboratory activities during the day without using special equipment.

Katydids (Tettigoniidae)

Katydids, although often bred with difficulty, are readily maintained in the laboratory. Most Michigan species survive well in the above-described grasshopper cage and under somewhat the same conditions, but they require partial shelter from strong sunlight, and their food-habits are more diverse.

Among native food-plants, the flowers and leaves of a large number of herbs and shrubs—no grasses—are acceptable to most species except the cone-headed katydids, which eat only the seeds of grasses and sedges, and the shield-backed katydids, which have food-habits similar to those of ground and field crickets. Genera of food-plants especially attractive to Michigan bush and round-headed katydids, as well as to many others, are *Cornus, Daucus, Helianthus, Impatiens, Oxalis, Rhamnus, Typha, Sagittaria, Solidago,* and *Vitis.* Lettuce is the best laboratory food for katydids, being attractive to all species except cone-heads. Bran and oats, the latter being preferred, are useful supplements to a lettuce diet or are used alone. No water supply is needed unless the food is dry.

Depending on the species, katydids lay their eggs in the stems of grasses and sedges, in galls, between the upper and lower surfaces of the leaves of herbs and woody plants, in the bark of woody plants, and occasionally in the ground (Blatchley, '20). Because of these varied and stringent oviposition requirements, katydids are somewhat difficult to rear. Nevertheless, many can be carried through their entire life cycle in the laboratory, providing their oviposition requirements are met. This usually involves placing in their cage a potted seedling or mature, small plant of the proper host.

Most katydids, unlike grasshoppers, are nocturnal insects, their activities occurring at dusk or during the early part of the night. Consequently, to observe their normal activities in the laboratory a low intensity light, *e.g.,* a flashlight, is used. Such a light does not disturb them, yet provides sufficient illumination. Infra-red techniques may also be used.

To be continued

Subimaginal molt of Caenis hilaris (Say) (Ephemeroptera: Caenidae)[1]

By Calvin R. Fremling, Winona State College, Winona, Minnesota

Edmunds (1956) in a review of exuviation in flight of subimaginal Ephemeroptera, stated that he has observed *Caenis simulans* McDunnough to molt while at rest. The following observation tends to substantiate his contention that *Caenis* only "appears" to molt during flight as it drops the subimaginal exuviae which have clung to the imaginal cerci.

At 7 p.m. (C.S.T.) on August 22, 1957, large numbers of *Caenis hilaris* (Say) subimagoes were observed to molt on an overturned life boat at Lock 19, Keokuk, Iowa. Immediately upon alighting, the wings of the subimagoes were held horizontally and exuviation was quickly initiated. The longest elapsed time for a subimago to land, molt, and fly away as an imago, was 65 seconds and the shortest observed time was only 8 seconds. Apparently, molting was hastened by the onset of darkness, and after 7:10 p.m. very few subimagoes took longer than 10 seconds to land, exuviate and fly away. The subimaginal exuviae often remained attached to the imaginal cerci when the imago took to the air. Subimagoes, in undiminished numbers, were still molting at 7:20 p.m. when darkness rendered observation difficult.

Literature Cited

Edmunds, G. F. Jr. 1956. Exuviation of subimaginal Ephemeroptera in flight. Ent. News 47: 91–93.

[1] Journal Paper No. J.-3715 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1373, Iowa Cooperative Fisheries Research Unit, sponsored by the Iowa State Conservation Commission and Iowa State University of Science and Technology, with the cooperation of the U. S. Fish and Wildlife Service. This project was also supported by the National Science Foundation grant G-3831.

New Exotic Crane-Flies (Tipulidae: Diptera). Part I

By Charles P. Alexander, Amherst, Massachusetts [1]

In the present series of papers I am describing new species of extra-North American crane-flies. The materials considered at this time are from Argentina, Chile and Peru, having been received from colleagues, including Schachovskoy in Argentina, and Peña in Chile. The very interesting fly from Peru was sent to me by my long-time friend and fellow worker on the Tipulidae, Dr. Bernhard Mannheims, of Bonn, Germany. I am very greatly indebted to these friends for this small series of crane-flies.

Austrolimnophila (Austrolimnophila) mannheimsi new species

Size medium (wing of male over 11 mm.); mesonotal praescutum brownish yellow with an intermediate pair of darker brown stripes; pleura yellow with small dark spots; legs dark brown; wings obscure yellow, with abundant brown dots in all cells.

♂. Length about 12 mm.; wing 11.5 mm.; antenna about 2.5 mm.

Described from an alcoholic specimen. Rostrum light yellow; palpi brown, the first segment yellow. Antennae relatively short; basal three segments yellow, the remainder light brown; segments subcylindrical, the intermediate ones subequal in length to their verticils. Head dark brown.

Pronotum narrowly darkened medially, broadly yellow on the sides. Mesonotal praescutum brownish yellow with a pair of darker brown intermediate stripes, the usual lateral pair lacking; scutal lobes conspicuously infuscated, central area yellow; posterior sclerites of notum light brown, the katapleurotergite darker. Pleura yellow, with small dark spots above the mid-

[1] Contribution from the Entomological Laboratory, University of Massachusetts.

coxae and on the meron. Halteres elongate, medium brown, base of stem restrictedly pale. Legs with coxae and trochanters yellow; remainder of legs dark brown. Wings with the ground obscure yellow, the entire surface with abundant brown dots in all cells and virtually equal in size throughout; a slightly larger concentration on the anterior cord; veins slightly darker brown. Venation: R_{2+3+4} longer than the basal section of R_5; *Rs* long, cell M_1 deep, its petiole shorter than *m*; *m-cu* at near one-third the length of M_{3+4}; weak secondary veins behind both Anal veins, as frequent in the genus.

Abdominal tergites brown, the transverse basal impressions pale; sternites weakly bicolored, yellow, patterned with pale brown basally and on sides, in cases virtually crossing the sternites to form a band; hypopygium brownish yellow. Male hypopygium with the tergite transverse, the posterior border virtually truncate, the median part a very little produced and provided with a fringe of long conspicuous setae; proctiger large and membranous, pale. Basistyle narrowed outwardly, on ventral face near base with a large subtriangular darkened lobe, its apex subtruncate. Outer dististyle longer, appearing as a gently curved rod, provided with setae, the outer apical angle produced into a slender black spine; inner style a little shorter, very gently curved, tip narrowly obtuse. Gonapophysis appearing as a flattened plate, the posterior lateral angle produced into a slender spine that is directed caudad.

Habitat. PERU. *Holotype:* alcoholic ♂, Hacienda Udima, near Taulis, circa 6°50′S. Lat., 79°10′W. Long., in mountain forest, 1,600–2,200 meters; end of December 1952 (leg. H. W. Koepcke), No. 6949; Museum Alexander Koenig, Bonn, Germany.

This interesting fly was sent to me by my long-time friend and co-worker on the Tipulidae, Dr. Bernhard Mannheims, of Bonn, to whom the species is dedicated. There are several allied species in the Chilean Subregion, including *Austrolimnophila* (*Austrolimnophila*) *bradleyi* Alexander, *A.* (*A.*) *martinezi* Alexander, *A.* (*A.*) *merklei* Alexander, *A.* (*A.*) *nahuelicola* Alexander, and *A.* (*A.*) *tunguraguensis* Alexander, all with

somewhat similarly dotted and spotted wings, all separable among themselves by the coloration, wing pattern and venation, and especially in the structure of the male hypopygium.

Gynoplistia schachovskoyana new species

Size large (wing over 20 mm.) abdomen very long; antennae 19-segmented, with eleven branched segments; femora yellowish brown, paler apically, enclosing a narrow brown subterminal ring; wings subhyaline, conspicuously spotted and dotted with brown.

♂. Length about 30 mm.; wing 22 mm.; abdomen alone 25 mm.

♀. Length about 33 mm.; wing 21.5 mm.; abdomen alone 27 mm.

Rostrum brown; palpi brownish black. Antennae moderately long, dark brown to brownish black, the incisures of the more proximal flagellar segments paler; 19-segmented, the formula 2 + 2 + 9 + 6, in both sexes; branches in male only a little longer than in the female, the longest slightly more than one-third the entire organ; terminal segment elongate, about one-half longer than the penultimate. Head dark brown, flecked with brownish yellow, the vertex and genae beneath extensively gray pruinose, especially distinct as a central line on the posterior vertex.

Pronotal scutum whitish yellow, patterned with dark brown, the scutellum more uniformly horn-yellow with a whitish spot on either side. Mesonotal praescutum with the ground brownish yellow, pollinose, with three brown stripes, the median one divided by a narrow black vitta that extends about to three-fourths the length of the sclerite; lateral praescutal borders more fulvous, more or less pruinose; pseudosutural foveae large, pale brown; posterior sclerites of notum chiefly white pruinose, with a more or less distinct darker central vitta, most evident on the mediotergite and apparently not caused by rubbing. Pleura dark brown above, including the dorsopleural region, paler surrounding the anterior spiracle; ventral half paler brown with

a conspicuous silvery stripe, most evident from the fore coxa across the dorsal sternopleurite to the base of abdomen; a dark spot above the hind coxa on metepisternum. Halteres with stem white, knob infuscated. Legs with coxae dark brown, heavily pruinose; trochanters brownish yellow; femora yellowish brown, paler apically, before tip with a narrow brown ring; tibiae yellowish brown, the tips broadly infuscated; tarsi brown, the outer segments brownish black. Wings with the ground subhyaline, the outer cubital and anal cells weakly infuscated; a conspicuous brown spotted and dotted pattern, including major areas in the radial field, particularly in *R* and bases of the outer radial cells; stigma brownish yellow, variegated by brown markings; abundant smaller dots in costal field and more scattered in cells *M* and *Cu;* larger clouds in cell *1st A* at near two-thirds the length and in *2nd A* at midlength; other narrow seams at outer end of cell *1st* M_2, fork of M_{1+2}, base of vein *2nd A,* and less evidently along the posterior margin; veins brown. Venation: R_{2+3+4} one-half the basal section of R_5 or a little longer; cell M_1 approximately three times its petiole.

Abdomen very long in both sexes, as shown by the measurements; brownish gray to brown, the lateral tergal border with a narrow dark brown line that is only slightly interrupted on the basal rings; hypopygium small.

Habitat. ARGENTINA. *Holotype:* ♂, Lago Lacar, Neuquen, 650 meters, January 22, 1954 (S. S. Schachovskoy). *Allotopotype:* ♀, January 12, 1954.

I take pleasure in naming this striking fly for the collector, Mr. Serge S. Schachovskoy, to whom I am indebted for many interesting crane-flies from Neuquen. The large size, very long abdomen, and conspicuously patterned wings readily distinguish the species from all known relatives. The smaller *Gynoplistia pictipennis* (Philippi) likewise has patterned wings but is entirely distinct.

Molophilus (Molophilus) pastoris new species

Belongs to the *plagiatus* group; mesonotal praescutum and scutum light brown, the postnotum and pleura dark brown; male

hypopygium with the basal dististyle an unusually long simple blackened rod, with nearly the outer half strongly curved and narrowed; phallosome a setiferous cushion, its apex shallowly emarginate.

♂. Length about 3.7 mm.; wing 4.5 mm.; antenna about 1.3 mm.

Rostrum and palpi black. Antennae of male moderately long, as shown by the measurements; basal segments obscure yellow or brownish yellow, the outer flagellar segments more darkened; flagellar segments oval to long-oval, with long conspicuous verticils and erect pubesence. Head dark brownish gray.

Pronotum dark brown, the scutellum and pretergites testaceous yellow. Mesonotal praescutum, scutum and scutellum light brown, the humeri more reddened; postnotum and pleura dark brown. Halteres pale yellow. Legs with coxae and trochanters yellow; femora yellowish brown to light brown, tibiae and tarsi darker brown; subbasal ring of fore tibia more blackened, conspicuous. Wings tinged with grayish yellow, the prearcular and costal fields clearer yellow; veins dark yellow; macrotrichia brown. Venation: R_2 lying a short distance beyond the level of *r-m;* petiole of cell M_3 relatively short, only a little longer than *m-cu;* vein *2nd A* only gently sinuous.

Abdomen dark brown, the hypopygium a very little brighter. Male hypopygium with the beak of the basistyle slender, acute at tip. Outer dististyle with the stem slender, the arms very unequal; basal style an unusually long simple blackened rod, with more than the basal half stout, the more slender outer part strongly curved, terminating in a long black spine. The structure suggests a shepherd's crook, whence the specific name. Phallosome a setiferous cushion, the apex rather shallowly emarginate.

Habitat. CHILE. *Holotype:* ♂, Aucar, Chiloe Island, January 6–15, 1952 (Luis E. Peña).

Molophilus (*Molophilus*) *pastoris* is most similar to species such as *M.* (*M.*) *fagetorum* Alexander, *M.* (*M.*) *rubidithorax* Alexander, and others, differing especially in the structure of the male hypopygium, particularly the basal dististyle.

Molophilus (Molophilus) stenorhabda new species

Belongs to the *plagiatus* group; mesonotum chiefly reddish yellow, the postnotum and pleura slightly darker; halteres pale yellow; male hypopygium with the beak of the basistyle very slender; basal dististyle an unusually long and slender simple rod, narrowed to the acute tip; phallosome a setiferous cushion, its outer end deeply emarginate.

♂. Length about 3.5 mm.; wing 4 mm.
♀. Length about 3.8 mm.; wing 4 mm.

Rostrum brown; palpi black. Antennae dark brown, of moderate length, if bent backward extending approximately to the root of the halteres. Head dark brownish gray.

Pronotum testaceous. Mesonotum chiefly reddish yellow, the praescutum somewhat more darkened medially in front; postnotum and dorsal pleura slightly darker. Halteres pale yellow. Legs with the coxae and trochanters yellow; remainder of legs obscure yellow, the color more obscured by dark setae. Wings weakly darkened, the prearcular and costal fields more yellowed; veins yellow, brighter in the yellowed portions. Venation: R_2 lying just beyond level of *r-m;* petiole of cell M_3 about one-fourth longer than *m-cu;* vein *2nd A* only moderately sinuous, ending about opposite the anterior end of *m-cu.*

Abdomen dark brown, hypopygium yellow. Male hypopygium with the beak of the basistyle very slender, acute at tip. Outer dististyle with the arms very unequal, the inner one slender; basal style an unusually long and slender simple rod, blackened, narrowed to the acute tip. Phallosome a setiferous cushion, its outer end deeply emarginate, the notch about twice as broad as either lobe, the longest setae on the lobes.

Habitat. CHILE. *Holotype:* ♂, Rio Coluco, Chiloe Island, January 30, 1952 (Luis E. Peña). *Allotopotype:* ♀, pinned with type. *Paratopotype:* ♀, pinned with type.

In its general appearance and structure of the male hypopygium, the present fly is most similar to *Molophilus* (*Molophilus*) *rubidithorax excavatus* Alexander, differing especially in the structure of the male hypopygium, particularly the unusually attenuated basal dististyle.

Fleas from Iraq

By C. Andresen Hubbard, Tigard 23, Oregon

It has now been six years since I returned from Iraq, the most eastern of the Arab states, the one bordered on the east by Iran (Persia), where the Fulbright program had sent me as a researcher to study fleas and plague. Upon my return to the States I spent six months studying my data and writing a paper on the new fleas secured, the six being described in Iraq Natural History Museum Publication No. 11, released December 20, 1956. Another year was spent incorporating all my personal collection records from Iraq with all the known flea records of the entire Arab world, the results a manuscript designed to be a textbook with coverage from Morocco through Algeria, Tunisia, Libia, Egypt, Sudan, Saudi Arabia, Syria and Iraq. This paper has been in the hands of the Iraq Museum of Natural History awaiting publication for several years. I understand it was partially set up when, on July 14, 1958, the World was informed that King Faisal of Iraq had been assassinated and a republic declared. I expect this coup will greatly delay the publication of any American papers in Iraq so I think my records from this country can be published in the United States at this time without in any way lessening the value of the larger paper.

Iraq is not a large country. It is irregularly shaped and extends, perhaps, 600 miles from north to south and from east to west. Except for the irrigation systems of the Tigris and Euphrates rivers the southern 450 miles are desert. The northern 150 miles are mountainous Kurdistan, the hills being clothed with evergreen and deciduous trees. Such being the case, desert rodents with their desert rodent fleas are found in the desert; woods mice and squirrels with their special fleas in the northern hills; and domestic fleas, cat, dog, human, in the villages and towns where people are concentrated. The carnivors, as in other countries, carry the fleas of their prey.

The work of the siphonapterist and mammologist in Iraq is rather trying. There seems a small Arab boy behind every bush and as soon as the investigator's back is turned the children

make off with the traps to add them to the families ever scarce wood supply. If the traps escape the small boys (adults also) the always hungry jackals quickly devour the trapped mice, even to skillfully removing them from small box traps. By comparison an investigator in America could take as many fleas in his country in one night as in over a month or more in Iraq.

My Iraq records follow.

1. **Pulex irritans** Linne 1758. (human flea) Baghdad off man, 5 pairs, April 15, 1953.
2. **Ctenocephalides canis** (Curtis) 1826. (dog flea) Bagdad off domestic dog, 1 male, January 17, 1953; off *Canis a. aureus* (jackal), 1 female, January 24, 1953; Babylon off *Lepus e. connori* (rabbit), 1 pair, April 26, 1953.
3. **Ctenocephalides felis felis** (Bouche) 1835. (cat flea) Baghdad off domestic cat, 6 pairs, May 1, 1953; Babylon off *Felis chaus furax,* March 15, 1953.
4. **Synosternus pallidus** (Taschenberg) 1880. Baghdad west off *Hemiechinus auritus calligoni* (hedgehog), 1 female, April 14, 1953; Baghdad, 15 miles north on Tigris river off *Lepus europaeus connori* (hare), 2 pairs, May 21, 1953.
5. **Synosternus cleopatrae** (Rothschild) 1903. Baghdad, 15 miles out Falluja road off *Meriones c. crassus* (jird-gerbil), 8 males, 4 females, May 28, 1953.
6. **Xenopsylla cheopis** (Rothschild) 1903. (oriental rat flea) Baghdad (Y.M.C.A.) off *Rattus norvegicus* (Norwegian rat), 1 pair, April 15, 1953; Baghdad off *Rattus rattus* (black rat), 1 pair, May 26, 1953; Babylon off *Rattus norvegicus,* 1 pair, April 25, 1953.
7. **Xenopsylla nubica** (Rothschild) 1903. Basra, 40 miles northwest off *Jaculus loftusi* (jerboa), 2 pairs, January 31, 1953.
8. **Xenopsylla astia** (Rothschild) 1903. Baghdad off *Nesokia i. buxtoni* (mole rat), 3 males, February 3, 1953, 5 pairs, February 7, 1953; Baghdad, 7 miles northeast off *Gerbillus dasyurus mesopotamiae* (Harrison's gerbil), 2 males, March 29, 1953; Baghdad, 20 miles out Kut road off *Gerbillus d. mesopotamiae,* 3 males, May 15, 1953; Hilla off *Nesokia indicus buxtoni,* 1 male, 8 females, April 24, 1953; Hilla, 5 miles west at police compound off *Tatera indica taeniura* (date rat), 3 pairs, April 26, 1953;

Babylon Junction off *Tatera i. taeniura,* 1 male, April 24, 1953.

9. **Xenopsylla conformis conformis** (Wagner) 1903. Ramadi, 10 miles west, off *Meriones crassus crassus* (jird-gerbil), 15 pairs, April 8, 1953; Baghdad, 20 miles west, off *Meriones c. crassus,* 2 pairs, April 14, 1953; Baghdad, 9 miles north, 7 pairs, April 17, 1953, 3 males, 5 females, April 18, 1953.
10. **Coptopsylla smiti** Hubbard 1956. Baghdad (New Baghdad Race Track) off *Gerbillus d. mesopotamiae* (Harrison's gerbil), 1 male, January 31, 1953.
11. **Stenoponia tripectinata irakana** Jordan 1958. Baghdad (Karradit Mariam) off *Mus m. praetextus* (house mouse), 1 male, January 28, 1953; Baghdad (New Baghdad Race Track), off *Gerbillus d. mesopotamiae,* 1 female, February 5, 1953.
12. **Ctenophthalmus congener allousei** Hubbard 1956. Sirsang, off *Microtus irani* (Persian meadow mouse), 1 male, 2 females, June 28, 1953.
13. **Rhinolophosylla unipectinata unipectinata** (Taschenberg) 1880. Baghdad (Mustansiriyah) off *Asellia tridens* (trident leaf-nosed bat), 1 female, May 26, 1953.
14. **Chiropteropsylla brockmani johnsoni** Hubbard 1956. Baghdad (Mustansiriyah) off *Asellia t. murraiana* (trident bat), 1 female, May 26, 1953.
15. **Nosopsyllus medus** Jordan 1938. Baghdad (east) off *Mus m. praetextus* (house mouse), 1 female, February 4, 1953; Baghdad (west, Karradat Mariam), off *Mus m. praetextus,* 3 pairs, February 5, 1953; 1 female, March 31, 1953; Babylon off *Rattus norvegicus* (Norwegian rat), 2 females, April 25, 1953.
16. **Nosopsyllus pringlei** Hubbard 1956. Ramadi, 10 miles west, off *Meriones c. crassus* (gerbil), 1 female, April 8, 1953; Ramadi, 15 miles west, off *Meriones c. crassus,* 2 females, April 8, 1953; Baghdad, 7 miles northeast, off *Gerbillus d. mesopotamiae,* 1 male, March 29, 1953; Baghdad, 9 miles north, 2 females, April 17, 1953.
17. **Nosopsyllus durii** Hubbard 1956. Sirsang, off *Microtus irani* (Persian meadow mouse), 3 males, 2 females, June 28, 1953.
18. **Nosopsyllus bunnii** Hubbard 1956. Basra, 40 miles northwest, off *Jaculus loftusi* (jerboa), 3 females, January 31, 1953; Baghdad, 20 miles west, off *Meriones c. crassus* (gerbil), 2 females, April 14, 1953.

The writer feels that the above records only touch the surface of siphonapteran investigation in Iraq. Any student of fleas realizes that fleas are seasonal and that it takes up to as many years as the writer spent months in Iraq to do the field justice. The squirrels and mice of northern Iraq (Kurdistan) and the fossorial animal *Spalax* remain untouched. The carnivors of the country are little known from the standpoint of ectoparasites. The relation of the fleas of the country to plague is still unexplored. To the student interested in fleas and plague Iraq is almost a virgin field.

The writer is indebted to Mr. Frans Smit, Curator of the Rothschild Collection of Fleas at Tring, England, and Dr. Robert Hatt, Director of Cranbrook Institute of Science, Bloomfield Hills, Michigan, who acted as mammologist on the Fulbright panel in Iraq during 1952–1953, for technical assistance given.

N.B. During October of 1958 Dr. Bashir Allouse, Director of the Iraq Natural History Museum in Baghdad, Iraq, mailed out Part One of "Fleas and Plague in Iraq and the Arab World" as Museum's Publication No. 15. Included in the 60-page introduction, which Part One is, are known fleas listed from all Arab states, the plague situation in the Middle and Near East and all present American techniques used in field and laboratory plague studies. Part Two, scheduled to be published during 1959 will contain the description of 70 Arab fleas with their ranges, and will possibly cover 200 pages. However, the continued unrest in the country, the writer's inability to communicate with Dr. Allouse for the past 6 months and the unfavorable feeling expressed in Iraq for Americans and British may delay publication of Part Two indefinitely. Therefore the writer is releasing this list of Iraq fleas at this time.

N.B.N. The writer was informed during the summer of 1959 that Dr. Allouse had found it expedient to be out of Iraq for the time and that Part Two of his paper, although on the press, was left without a proof reader or editor; therefore its appearance will be delayed indefinitely.

The Male of Chaoborus (Sayomyia) annulatus Cook [1]

By Edwin F. Cook

When *Chaoborus annulatus* was described originally (Cook, 1956) only 21 female specimens were available. In 1957, Frank W. Mead of the State Plant Board of Florida collected a number of this species among which were three males which he sent to me for examination. The following description is based on these specimens.

Male:

Total length approximately 3.50 mm. Setae all very light tan except those arising from darkly pigmented areas somewhat darker brown. General body color very light grey with faint brown pattern on thorax and abdomen; legs conspicuously ringed with brown.

Head: Head capsule white; pedicel white with faint brown tinge; flagellar segment white except for brown rings at each whorl of flagellar setae; palpal segments all light brown.

Head width 0.70 mm.; width between eyes 0.27 mm.; length of prementum 0.22 mm.; length of clypeus 0.19 mm.; length of penultimate antennal segment 0.19 mm.; length of ultimate segment 0.16 mm.; H.W./W.B.E. = 2.58; H.W./P.L. = 3.14; H.W./C.L. = 3.86; Pu.L./U.L. = 1.10.

Thorax: Color white with light brown markings. Anterior pronotal lobes white; posterior pronotum with a small brown area at upper angle; scutum with conspicuous brown vittae as in *C. punctipennis;* no marks around seta bases; scutellum white except for paired brown patches at posterior margin; postnotum brown; pre-episternum with a medial brown area; plural area otherwise white. Pronotal setae 11; proepisternals 9; posterior pronotals 1; pre-episternals 2; anepisternals 5; upper mesepimerals 3.

[1] Paper No. 4184, Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul 1, Minnesota.

Thoracic appendages: Wings whitish, marked with an incomplete pale brown crossband at the level of the bifurcation of M.; two irregular brown areas at m–cu and just basad of this, and with the costal margin darkened; no discrete, small, brown spots. Wing length 2.33 mm.; width 0.60 mm.; W.L./W.W. = 3.89. Leg structure and vestiture as in *C. punctipennis;* white, conspicuously marked with brown rings on femora and tibiae; apices of tarsal segments also dark.

Abdomen: Ground color white; each segment with conspicuous, lateral, trianglar, brown marking; seventh segment largely brown.

Genitalia: (fig. 1) Tergite and sternite of segment 8 with numerous long setae on posterior half; tergite 9 slightly produced medially, a pair of slightly developed basal lobes each bearing 12 long setae. Gonocoxite white on basal two-thirds, brown distally. Gonocoxite with a membranous, setaceous lobe. Gonostyle about one-fourth shorter than gonocoxite, pale brown, with a few minute setae. Penis valve simple, darkly pigmented apically. Coxite length 0.35 mm.; style length 0.25 mm.; Co.L./St.L. = 1.43.

Specimen examined: Two males, Columbia Co., Florida, Feb. 28, 1957, Coll. F. W. Mead; 1 male, Alachua Co., Florida, Oct. 16, 1953.

Comments: The male of this species can be separated readily from others of the subgenus *Sayomyia* in North America by the partially banded wings and the structure of the male genitalia.

Reference Cited

Cook, E. F. 1956. The Nearctic Chaoborinae (Diptera: Culicidae). University of Minnesota Ag. Exp. Sta. Tech. Bull. 218, pp. 1–102.

A New Record of Cyrtolobus auroreus Woodruff from Wisconsin (Homoptera)

By Clifford J. Dennis, East Central State College, Ada, Okla.

Four specimens, consisting of three males and one female, of *Cyrtolobus auroreus* Woodruff were among several thousand treehoppers collected in black light traps at Middleton, Dane County, Wisconsin on June 9, 1959. These insects were collected by Dr. John T. Medler, Department of Entomology, University of Wisconsin, and Mr. Phil W. Smith, Plant Industry Division, Wisconsin Department of Agriculture.

The specimens match Woodruff's (1924) description in all particulars except that his "rose" has a somewhat brownish cast on the female, and his "dark rose" on the males is very dark rose.

Frost (1955) reported the collection of this species from a tungsten filament light trap in Pennsylvania.

This collection of *Cyrtolobus auroreus* Woodruff in Wisconsin represents a new locality record.

Literature Cited

Frost, S. W. 1955. Ent. News 66: 63–64.
Woodruff, L. B. 1924. Jour. N. Y. Ent. Soc. 32: 1–62.

Notice. The December, 1959, issue of Entomological News was mailed at the Post Office at Lancaster, Pa., on December 11, 1959.

EXCHANGES

This column is intended only for wants and exchanges, not for advertisements of goods for sale or services rendered. Notices not exceeding three lines free to subscribers.

These notices are continued as long as our limited space will allow; the new ones are added at the end of the column, and, only when necessary those at the top (being longest in) are discontinued.

Bembicini and Stizini (Hym., Sphec.) of New World wanted for revis. study. Will return upon request or at end of project. James E. Gillaspy, Dept. of Zoology, Univ. Texas, Austin 12, Texas.

Agapema galbina. Will exchange cocoons of this moth for nature books. E. Frizzell, Route 4, Box 96, San Benito, Texas.

Tenebrionidae of the World wanted, in exchange for insects of Argentina and neighboring countries. Horacio J. Molinari, Av. Lib. Gral. San Martin 55, Acassuso (Buenos Aires), Rep. Argentina.

Butterflies. Wish to exchange specimens for Japanese species. Please write to Ichiro Nakamura (Boy, age 16), 26 Aza-Nichiyama Obayashi Takarazuka-shi, Hyogo-Ken, Japan.

Phasmidae of nearctic area desired alive. Purchase or trade, drawing on large stock of major orders, worldwide. Domminck J. Pirone, Dept. Entomology, Cornell University, Ithaca, N. Y.

Nitidulidae and Rhizophagidae wanted in exchange for European beetles of all families. O. Marek, Zămberk 797, Czechoslovakia.

Wanted and Needed. We are compiling a history of entomology, and particularly, at present, of the amateur insect clubs that flourished 50 to 75 years ago. Will you who have knowledge of such early clubs or societies advise me, giving facts on the time of existence, members, etc., which you may have. J. J. Davis, Dept. of Entomology, Purdue University, Lafayette, Indiana.